REMARKS – General

By the above amendment, Applicant is amending the Specification and Claims to define the invention more particularly and distinctly so as to overcome the technical objection and the § 112 objections, and to define the invention patentably over the prior art.

The Restriction Election Has Been Made To Restrict The Prosecution Of This Application To Claims 1-20

The Examiner has observed and pointed out that claims 1-20 are drawn to a multiple fiber optic apparatus, classified in class 385, subclass 137, whereas claims 21-36 are drawn to a method of manufacturing fiber optic apparatus, classified in class 156, subclass 158. Applicant hereby confirms and asserts his election that this application be prosecuted on the invention drawn to a multiple fiber optic apparatus, rather than on a method of manufacturing fiber optic apparatus. Applicant therefore requests that claims 21-36 be withdrawn from consideration and be thereby cancelled.

In the First Office Action, under the heading "Elections/Restrictions", on the first line of paragraph "1.", in the sentence beginning, "Claims 31-36", Applicant respectfully interprets to mean, "Claims 21-36", since only this interpretation is consistent with the other instances of mention of the range of claims identified as being on an invention drawn to a method of manufacturing fiber optic apparatus.

There is no cause to amend the inventorship, as both named inventors contributed to claims from both the elected claims and the non-elected claims.

The Objections To The Patent Numbers Referenced In The Specification, And Response

Per examiner's observation, on page 1 in paragraph 0001, the referenced co-pending application should include the application number of that application, which is 09/825,821. Applicant also

wishes to add the word "hereby" in paragraph 0001. An amendment of paragraph 0001 is therefore requested as given above.

Per examiner's observation, on page 2, paragraph 0003 (continued from page 1), the referenced patent numbers begin with an unwanted extra digit that should be deleted by a) changing the incorrect "15,809,188" to a correct "5,809,188" and b) changing the incorrect "25,781,675" to a correct "5,781,675". An amendment to paragraph 0003 is therefore requested above to delete these misleading leading digits.

Claim Objections, Claim Rejections Under 35 USC § 112, And Responses To Same

The objections to claims 1-6 are addressed by requesting an amendment to claims 1. In claim 1, the amendment changes "a second array" to "a first array", and changes "said array" to "said first array".

The claim rejections of claims 1-6 are overcome by further amending claims 1. Within claim 1, the word "common" and the phrase "which may be of different types" are deleted.

Although not in response to an objection, in claim 2, an amendment changes "said array" to "said first array" for better clarity, and the unnecessary word "actually" is deleted.

Accordingly, applicant submits that the specification does comply with § 112 and requests withdrawal of these objections.

Claim Rejections Under 35 USC § 102(b), and Responses To Same

A first group of claims (1, 4-6, 10, 11, 15, 16, 18, and 20) was rejected under 35 USC § 102(b) as being anticipated by Shaw et al. (US 4,601,541). Of these claims, claims 4-6 are dependent claims dependent upon independent claim 1; claim 11 is dependent upon independent claim 10; and claim 20 is dependent upon independent claim 18. Of these same claims, claims 1, 10, 15, 16, and 18 are independent.

The § 102(b) rejection of independent claim 1 and its dependent claims 4-6 is based on the stated observation, "Shaw et al. discloses a fiber optic coupler 10, comprising crystal substrate having first surface 17, a first array of groove 18 etched into the surface, an array of fibers 13 held in the grooves, wherein the fibers are held in the substrate forms a coupler." And this rejection furthers states, "For claim 4, the substrate is disclosed to be silicon (column 3, line 23), for claims 5 and 6, the device is joiner and a coupler." Significant differences exist from the art disclosed by Shaw et al. and what is claimed in the current patent application within claims 1-20. Whereas Shaw does not, in fact, disclose an array of grooves in a first substrate, Applicant's claim 1 does claim "a first array of grooves etched into said first surface". The only array disclosed by Shaw is "a plurality of fiber optic strands", and his only disclosure of a means to hold these fibers is not within an array of grooves, but rather between two opposing surface 38. Relative to his Figures 5 and 6, Shaw et al. state in column 6, beginning on line 13: "As illustrated, bases 32 comprise generally rectangular blocks of quartz or other suitable rigid material having confronting faces or surfaces 38 and outer faces or surfaces 39. The central portions 41 of surfaces 38 are planar and parallel to surfaces 39, and toward the edges of the blocks surfaces 38 curve away from central portions 41." Shaw et al. go on also in column 6, but beginning on line 36: "In one presently preferred method of manufacture for the coupler of FIGS. 5-6, the surfaces of blocks 32 are first ground flat and parallel. Thereafter, the desired curvatures are formed toward the outer edges of surfaces 38. The glue is then applied to the contoured surfaces, and the fiber optic strands are placed on the blocks and pressed against surfaces 38 while the glue cures." Nowhere do Shaw et al. disclose or even suggest that more than a single groove be manufactured within a single substrate. Applicant's claim 1, in contrast, claims not only "a first array of grooves", but also claims an "array of side-polished optical fibers held within said first array of grooves".

Applicant submits, therefore, that Applicant's claim 1 does not read on the work of Shaw et al., and that Applicant's claim 1 stands as novel against the disclosure of Shaw et al..

Applicant's claims 4-6 are dependent upon claim 1. If claim 1 is novel, then claims 4-6 also are consequentially novel. In further regard to claim 4, although Shaw et al. disclose silicon as a

possible substrate, they make no mention of any particular form of silicon, and in particular, do not mention it being "crystal" or "crystalline" or the like.

The § 102(b) rejection of independent claim 10 and its dependent claim 11 is based on the stated observation, "For claim 10, the polished area of the fiber is divided into two parts and both are associated with the substrate. The fibers are joined without any connector or splicing. For claim 11, portion of the substrate is considered substrate strip." Applicant respectfully points out that claim 10 claims elements including "at least a first fiber" and (before amending) "two or more side-polished areas along said first fiber". Claim 10 doesn't stipulate a required second fiber. More importantly, Applicant can find no basis within Shaw et al. for even two side-polished areas along a single fiber. Shaw et al. only disclose fibers each of which have a single side-polished area, that is one per fiber. Applicant feels it may be improper, based upon the definition and usage of the term "side-polished area" given within Shaw et al., or within the applicant's application, to mentally "divide" a side-polished area into two portions and refer to them equivalently as "two or more side-polished areas" and "two parts". Furthermore, whenever Shaw et al. refer to two side-polished areas being associated with fibers, it is with two respective fibers with one side-polished area on each (not together on a single fiber). Probably due to yield issues in the formation of a groove mechanically cut into quartz, Shaw et al. focus only on making one side-polished fiber (or a group of side-polished areas on a group of fibers) in only one groove and only on one substrate at a time. Regarding, "The fibers are joined without any connector or splicing", Applicant respectfully submits that Shaw et al. are referring to "joined" as "evanescent coupling" (that takes place between two fibers across their mutually facing side-polished areas), and that this does not have any relation to the end-to-end connections (end-to-end joining, end-to-end coupling, or end-to-end splicing) that would be needed to associate the multiple fibers of Shaw et al. into a then continuous fiber spanning two or more independent side-polished areas. Even if such end-to-end connections were to be accomplished between the fibers of Shah et al., each end-to-end connection would incur unwanted coupling and reflection losses as well as induce discontinuities that could add polarization dispersion and other such negative factors on overall optical performance. One of the biggest needs within the optical communications industry is a means by which to reduce or eliminate the losses and other deleterious effects caused by end-to-end connections. The capability of eliminating many end-to-end connections in the creation of multiply interconnected

fiber optic apparatuses gives claim 10 a remarkable and much needed novelty to the field of fiber-optic communications and other application areas.

To give claim 10 added clarity for the purpose of making the above distinction and avoiding the rejection, Applicant is amending claim 10 by adding that the two side-polished areas are separated by a distance along the one fiber, and that a respective substrate portion is associated with each of said two side-polished areas, there being no splices or connectors within said fiber along said distance.

To define claim 11, an independent claim, even more definitively over Shaw et al., it is being amended above to include a further limitation, that of "wherein each of said substrate portions includes a respective portion of groove used to hold the fiber". For reference by claim 12, which depends upon claim 11, a further amendment to claim 11 adds "a first side opposite a second side" to the substrate strip.

The § 102(b) rejection of independent claims 15, 16, and 18 (along with claim 20 which depends on claim 18) is based on the stated observation, "For claims 15, 16, 18, and 20, the fibers, the substrates and bonding of fibers to the substrate are disclosed". The above amendments to the independent claims 15, 16, and 18 should make them, along with claim 20 that depends on 18, novel over Shaw et al. and other prior art, none of which disclose multiple fiber optic apparatuses* within grooves, and none of which has thought to, or found a way to, have the length of side-polished fiber be free of structural supports such as grooves or another fiber (*see note on definition of "apparatus" in next paragraph).

Note that within the specification, Applicant's demonstrated usage of the word "apparatus" is one that means not just unadulterated fiber-optic fiber, but "fiber-optic fiber that is structurally altered from its generally circular or elliptical cross-sectional shape (e.g. by side-polishing) and/or made to interact optically with another fiber over a finite length of fiber". Accordingly paragraph 0002 is amended to include this definition based upon its original usage throughout the specification.

Accordingly, claim 15 is amended to make it more distinctly claim what is novel. The first thing that is changed in this claim is a limitation of scope by the addition of "multiple grooves" added to at least two of the multiple substrate strips of paragraph "a". The next thing changed broadens the scope of "the multiple side-polished fiber optic apparatuses" of paragraph "b"; the limitation of "sandwiched between pairs of said substrate strips" now reads, "of which at least two are each sandwiched between a pair of said substrate strips, and each held within a pair of the grooves". The third change is that the "whereby" clause is eliminated, and the "wherein" clause made more restrictive to read, "wherein at least some of said multiple side-polished fiber optic apparatuses, with a sandwiching pair of substrate strips, are able to be stacked to form a multidimensional array of fiber optic apparatuses". Shaw et al. show, describe, or suggest no such arrangements. Applicant now submits that amended claim 15 clearly stands as distinct and novel against the reference of Shaw et al.

Also accordingly, claims 16 and 18, which originally claimed, respectively, a "freestanding" 2-port (i.e. one fiber) and a "freestanding" 4-port (i.e. two fibers) fiber optic apparatus, these fibers each having a side-polished area, are amended to more clearly limit their claimed structures by requiring at least one of the fibers be free of structural support (other than the fiber(s) themselves) over the side-polished length(s) of fiber. These amendments thereby now clearly differentiate their novelty over the reference of Shaw et al. which disclose side-polished fibers that are always bonded to a substrate at least along the length of fiber that has a side-polish. Furthermore, none of the fiber optic structures disclosed by Shaw et al. show, describe, or even suggest "free-standing" side-polished structure(s) as claimed.

Also accordingly, claim 20, being dependent upon claim 18, clearly differentiates novelty over the reference of Shaw et al.

Request for Withdrawal of Rejections Under 35 USC § 102(b)

In summary, regarding the § 102(b) rejections of the first group of claims (1, 4-6, 10, 11, 15, 16, 18, and 20) as being anticipated by Shaw et al. (US 4,601,541), Applicant submits that the amendments to claims 1, 2, 10, 11, 15, 16, and 18 as made and argued above now satisfy all of the

rejections by overcoming the reference to Shaw et al.. Applicant therefore respectfully requests the removal of rejections under 35 USC § 102(b).

Rejections Under 35 USC § 103(a)

The second group of claims (2, 3, 7-9, 12-14, 17, and 19) was rejected under 35 U.S.C. § 103(a) as being unpatentable over Shaw et al. (US 4,601,541) in view of Little (US 4,475,790) and Farries (US 5,778,119). Arguments supporting this rejection began with the above-discussed rejection under 35 U.S.C. § 102(b) based on Shaw et al.. It was then granted that Shaw et al. doesn't disclose multiple fibers in respective channels/grooves but only 'discloses the fibers in a single channel", and that Shaw et al. doesn't disclose looping of a fiber or of multiple fibers ("does not disclose loop system"). The rejection first makes observations that a) "Little, in figure 2 and 6, discloses substrate with multiple channels" and b) "Farries, in figure 4, discloses looping of fiber for coupling at more than one location".

Based on these first observational points, the § 103(a) rejection, argues that one skilled in the art would find it obvious to

a) "modify the substrate of Shaw et al. and provide several grooves or alternatively provide substrate in separate parts, as taught by Little";
b) "provide loop of the fiber so that more than one fiber can be accommodated or alternatively single fiber can be looped, for coupling with multiple mating fibers as taught by Farries so that the device can have multiple outputs"; and
c) place side-polished fibers individually into multiple grooves etched in crystalline silicon, since "for claims 2 and 3, the substrate of Shaw et al. is disclosed to be made of silica and can be etched along Miller planes".

Responses to Rejections Under 35 USC § 103(a)

In response to these rejections, first of all, Applicant asserts that the amendments made to claims 1, 2, 10, 11, 15, 16, and 18 in the first group of claims, in response to the § 102(b) rejections and discussed in the above sections presenting arguments supporting the novelty of the first group of

claims (as amended) over Shaw et al., now makes the invention claimed by the first group of claims stand as novel.

Regarding the Little and the Ferries references:

Little discloses multiple rhombic-shaped channels formed by arranging complementary opposed V-grooves on oppositely facing surfaces of silicon substrates. The V-grooves are preferentially etched in the silicon. He uses these channels to provide a means of supporting two-dimensional arrays of fibers for end-to-end connections to other similarly arranged arrays. His arrays of fibers form a connector bundle wherein each fiber is squeezed tightly between opposing grooves, with a crushable glass film lining the grooves to permit self-centering of the fibers along the axes of the channels. Little's two main motivations are evidently accurate and rigid alignment of the fiber ends in an array and providing a matrix between the fibers in an array which will withstand water under high pressure from leaking through the matrix as when his connector is used as part of a bulk-head pass-through in a submarine application.

Little discloses nothing about side-polished fibers and their ability to couple light between fibers, not by requiring fibers to be aligned end-to-end, but rather side-by-side. Furthermore, little makes no mention or discussion of the possibility of using a groove and channel to hold two fibers aligned end-to-end within a common channel to form a robust splicing of an array of fibers simultaneously. Little only describes one half of a connector, and it is presumed that one uses two such connectors placed face-to-face in order to effect a complete interconnection. Also, Little is dealing only with the alignment of relatively large fibers having 50-100um cores, and not the approximately 9um cores of typical single mode fiber optics. Thus there is no teaching or recognize by Little of the benefits of substrates with multiple V-groove for application in the field of side-polished fiber optics, and particularly not in single-mode fiber optics.

Ferries discloses fiber optic devices that use Bragg gratings to couple light "from the core to the cladding and then to the core region" in coupling the light from a first fiber to a second located alongside the first fiber. Ferries does not mention the notion of "looping" of a fiber. He does show (Fig. 4) and discuss "a series connection" (column 3, line 27; column 5, line 16) out of one

device and into another, but his depiction with lines of this "series connection" does not show a continuity of fiber form or size as being continuous over this connection. Applicant feels that this depiction and discussion by Ferries of "a series connection" is clear indication that he was not conceiving a continuous fiber without connectors and without splices which are commonly used in such applications. The 4-port devices that Ferries describes have the generic term of "directional couplers". With the addition of Bragg gratings, they become wavelength specific "directional couplers" or "add/drop" devices. At the time of Ferries's patent, and still today, these devices are sold only in single units, and one skilled in the art calls their interconnection "series connections", the same term that Ferries uses. Thus there is no basis for suggesting that Ferries anticipated a continuos fiber included within and running between two serially connected devices, free of connectors and splices.

To a second argument over Ferries, he doesn't mention substrates or supporting structure for holding fibers. His type of coupling (coupling from a core to a clad and then back to another core) is much more tolerant of dimensional misalignment than the core-to-core evanescent coupling of single mode couplers. This is most likely why Ferries does not address the challenges of side-polishing fibers for today's single-mode evanescent couplers. Thus he is not focused on the roll that fiber-holding substrates play in the manufacture and use of side-polished evanescent couplers. Accordingly, there is no basis within Ferries to suggest he was aware of an opportunity, let alone advantage, to route a fiber in a physical loop out of one substrate-supported side-polished device back into another side-polished device on the same substrate. In summary, Applicant finds no basis for accepting that one skilled in the art would be led by suggestion from Ferries to loop an unbroken original fiber through one device and into another, or even to do this between two devices on a common substrate. Applicant argues that combining the Ferries disclosure of "a series interconnection if devices" (certainly in itself, not a new idea, and containing no mention of "looping") with the disclosure of Shaw et al. would not make obvious, to one skilled in the art of the time, the invention of a single unbroken-fiber connection between and integral-part-of two side-polished devices, and certainly not between the two devices if on a single substrate.

Regarding that Shaw et al. mentions "silicon" and "etching along Miller planes", Applicant can not find any mention in the Shaw et al. patent (US 4,601,541) of "Miller planes". And the only

mention of "etch" in Shaw et al. is "so called 'bottle couplers' in which two fibers are twisted together in a glass tube and etched" (work by Sheem) and "Similarly, the material can be removed from the blocks and the cladding by other suitable techniques, such as etching and photolithography".

All that Shaw et al. says regarding "silicon" is the following: "One advantage of the fused quartz blocks is that they have a coefficient of thermal expansion similar to that of glass fibers, and this advantage is particularly important if the blocks and fibers are subjected to any heat treatment during the manufacturing process. Another suitable material for the blocks is silicon, which also has excellent thermal properties for this application." This citation would lead one to believe that Shaw et al. only mentions silicon because of its thermal expansion properties and not its ability to be etched along Miller planes.

Summary of Unobviousness Over Shaw et al. In View Of Little And Ferries

As presented or suggested by the above, Little discloses a means of holding together an array of fibers for later matching up with and optically connecting to another similar but physically separate array, thus effecting a means of implementing a mass connection end-to-end of one array of fibers to another physically separate array. That Little uses V-grooves to form multiple rhombic channels to hold and align multiple fibers singly within each channel seems totally unrelated to how V-grooves are used to hold side-polished fiber one per groove, and how rhombic channels formed of two V-grooves can end up surrounding two side-polished fibers place side-by-side to effect evanescent coupling. Laying fibers that are not side-polished into a V-groove and using another V-groove to form a channel with the first around the fiber (where no side-polishing is involved) is a process quite unrelated to fixing a fiber into one groove to use for polishing away the exposed side (to create a 2-port side-polished device) or then optionally placing two such groove/fiber pairs together to form a 4-port device. Thus it is not obvious that knowledge or experience of the former process would tend to suggest or otherwise make obvious the other, even given the art of Shaw et al. Thus using multiple fibers in a substrate for the former application does not suggest or make obvious using multiple fibers in a substrate for the latter application.

Also as presented or suggested above, Ferries depiction, and in particular his description, of a "series connection of devices" has no basis for suggesting that such "connection" is one effected with an unbroken original fiber. The weights of the lines and their separation depicting an interconnection between devices change and are different from those that depict the fibers within the devices (Fig. 4). Thus there is no basis to support that Ferries is suggesting a physically unbroken original fiber used not only between each device but as an integral part of each connected device. Thus it is not obvious that knowledge or experience with interconnecting the devices of Ferries would tend to suggest or otherwise make obvious the construction of side-polished devices along a length of a single unbroken original fiber. And since Ferries makes no mention of any supporting structures, his work does nothing to suggest how such structures can interplay with the fibers of his devices and their interconnection.

Accordingly, Applicant argues that one skilled in the art and familiar with Shah et al. would not recognize a possibility to utilize concepts from either Little or Ferries to come up with the novel ideas now claimed with the amended claims, and in particular the construction of multiple side-polished devices on a common substrate, construction of multiple side-polished devices along an unbroken original fiber, construction of side-polished devices along an unbroken fiber and placed together on a common substrate, and side-polished optical fibers supported by substrates beyond the lengthwise region of side-polish.

Amendments To Claims To Strengthen Unobviousness

Claims 1, 10, 11, 15, 16, and 18 are amended from the first group of claims (1, 4-6, 10, 11, 15, 16, 18, and 20) to strengthen their novelty over Shaw et al.. With the amending of parent claims 1 and 18 to assure they stand as novel over Shaw et al., their dependent claims 4-6 (dependent upon claim 1) and claim 20 (dependent upon claim 18), are made novel as well. Thus amendments made to the first group strengthen the novelty of all the claims within that group.

The second group of claims (2, 3, 7-9, 12-14, 17, and 19) was rejected under § 103(a) as being obvious. With the amendments made to claim 1 and discussed above in the first group of claims in response to the § 102(b) rejections, claims 2 and 3, from the second group, which depend upon

claim 1, now clearly overcome the § 103(a) rejection. No amendment is required of claim 3, but a small amendment is made to claim 2 to refine the wording of "said first array of grooves" by inserting the word "first".

Within this second group of claims, claim 9 depends upon claim 8 that in turn depends upon independent claim 7. Claim 7 is amended in a way which makes it more limited and definitive by specifying (in element "b") that its not generally the array of fibers that is sandwiched, but specifically "having side-polished areas" that are sandwiched. Claim 8 is also amended to be more definitive (and limited) in a like manner, such that its no longer "one of said side-polished fiber-optics" that is a 4-port apparatus, but more specifically now "one of said side-polished areas" that "participates in forming a 4-port apparatus". Dependent claim 9 is left unchanged. As argued in the previous section, these claims 7, 8, and 9 are unobvious over Shaw et al. in view of either or both Little and Ferries.

Within this second group of claims, claim 14 depends upon claim 13 that in turn depends upon independent claim 12. Furthermore, claim 12 depends upon claim 11 that depends upon independent claim 10, both from the first group of claims. Since independent claim 10 is amended and discussed in the previous section to be novel over Shaw et al., claims 12, 13, and 14 should now also be novel, thus overcoming the § 103(a) rejections of unobviousness. Nevertheless, claim 7 is amended to make it more novel and unobvious by removing the use of the term "loop" and replacing that with "wherein said substrate portions on said substrate strip are located at one of the group including on the same side and on opposite sides". (These "sides" are added by amending claim 11 as discussed in the previous section.) No amendment is made to claim 13. Claim 14 is amended to achieve improved clarity by replacing "forming" with "wherein said 4-port apparatus is" before "an optical add-drop multiplexer".

Claim 17 is not amended, but claim 19 is amended only to insert a hyphen in "side-polished". These dependent claims 17 and 19 are dependent upon independent claims 16 and 18 both of which are in the first group of claims and are amended in the sections above in defense of the § 102(b) rejections. Therefore, since amended claims 16 and 18 are submitted as novel, dependent claims 17 and 19 are considered unobvious.

Request for Withdrawal of Rejections Under 35 USC § 103(a)

For all of the above reasons, and with the amendments to the claims, Applicant submits that the current application, in the crowded and very active field of fiber optics, especially with the given amendments, is unobvious over Shaw et al. in view of Little and Ferries, as well as over all other prior art, and therefore requests withdrawal of this objection.

Additional Prior Art Made Of Record And Not Relied Upon

Prior art by Grubsky (US 6,360,038), Duerksen et al. (US 6,321,004) and Patterson et al. (US 6,356,684) all all said to disclose various aspects of the invention including multiple coupling locations and looping. These have also been considered by the applicant, and he finds no basis within them to show the lack of novelty or unobviousness in the current invention.

Applicant's detailed arguments against the art of Grubsky, Duerksen et al., and Patterson et al. are identical to the arguments already presented against the references of Shaw et al., Little, and Ferries, so will not be repeated again here.

Some general remarks, however, are made additionally for the record:

Grubsky discloses means (function more than form) of using Bragg gratings to cause light to couple from one fiber to another. Grubsky does not mention substrates, other fiber-supporting means, or side-polished fibers. The means that Grubsky discloses by which to construct his coupling devices is to hold fibers (with internal gratings) side-by-side (within 10 microns of one another) by using heat shrunk tubing over lengths ranging from 1mm to 500mm. Applicant can discern no basis from Grubsky therefore to appreciate arguments that anything disclosed therein might suggest any of the novelty which is Applicant's invention.

Duerksen et al. discloses architecture for a bi-directional WDM optical network that provides means for protective switching. Duerksen et al. focuses entirely on the logical view of

interconnecting optical fiber with optical device functions such as add/drop multiplexers, amplifiers, circulators, etc.. In column 5, starting on line 46, Duerksen says, "As used herein, the expression 'optically communicates' designates an optical path between two elements. The optical path may be a direct path or it may route through intermediate optical devices (e.g. optical isolators, additional optical circulators, filters, amplifiers, connectors, splitter/combiners, etc.)". Duerksen therefore does not disclose or discuss how optical devices are physically constructed, how they physically function, or how they are physically constructed. The closest he comes to describing how a device works is giving an example of a chirped Bragg grating as something that may comprise a "channel selector" (column 12, beginning on line 47). In column 7, beginning on line 54, Duerksen lists some "optical devices" that can be used as a channel selector, "Such devices include, but are not limited to, Bragg gratings, tunable Bragg gratings, Fabry_Perot filters, acousto-optic tunable filters, multilayer dielectric thin film filters, arrayed waveguide gratings (AWGs) and/or combinations of these devices". Neither the book by Ramaswami that Duerksen et al. references in column 1, line 22, nor any of the referenced patents give anything but simplistic, almost purely logical, descriptions of how a coupler or its related devices are constructed, and none in multiple or array form. Duerksen et al. and its references makes no mention of substrates, other fiber-supporting structures, or side-polished fibers. Applicant can therefore discern no basis from Duerksen et al. to appreciate arguments that anything disclosed therein might suggest any of the novelty which is Applicant's invention.

Patterson et al. discloses adjustable optical fiber grating dispersion compensators. These involve gratings set serially (cascaded) along the length of a fiber, a transducer to effect a change in grating pitch, a circulator, an optical tap (in one embodiment of the invention), and control circuitry. In one alternative configuration, an optical demultiplexer and multiplexer are both used to place the grating along parallel paths instead of cascaded serially along a single path (fiber). Even in discussing the transducer (column 6, lines 2-15), Patterson et al. names transducer categories such as "temperature" and "piezoelectricity" to effect stains in the gratings, but does not disclose any physical structures to describe these devices further. Patterson et al. and its references makes no mention of substrates, other fiber-supporting structures, or side-polished fibers. Applicant can therefore discern no basis from Patterson et al. to appreciate arguments that anything disclosed therein might suggest any of the novelty which is Applicant's invention.

Accordingly, applicant submits that the prior art by Grubsky, Duerksen et al., and Patterson et al. offers no basis within them to show the lack of novelty or unobviousness in the current invention. It is important to observe that the amendments given in this response remove any use of the word "loop" from the claims, and place emphasis not on logical interconnection architecture but rather on physical implementation as manifested in physical structures involving substrate materials and form and side-polished fibers, none of which are mentioned or referenced by Grubsky, Duerksen et al., or Patterson et al..

Conclusion

For all of the above reasons, applicant submits that the specification and claims are now in proper form, and that the claims all define patentably over the prior art. Therefore he submits that this application is now in condition for allowance, which action he respectfully solicits.

Conditional Request For Constructive Assistance

Applicant is amending the specification and claims of this application so that they are proper, definite, and define novel structure that is also unobvious. If for any reason this application is not believed to be in full condition for allowance, applicant respectfully requests the constructive assistance and suggestions of the Examiner pursuant to M.P.E.P. § 2173.02 and § 707.07(j) in order that the undersigned can place this application in allowable condition as soon as possible and without the need for further proceedings.

Very Respectfully,

Barclay J. Tullis John H. Prince

---- Applicants Pro Se ----
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2002 August 12 _____
Barclay J. Tullis, Applicant

Attachments:

-- Appendix 1 to Amendment A, With Replacement Paragraphs Marked-Up to Indicate Changes

-- Appendix 2 to Amendment A, With Replacement Claims Marked-Up to Indicate Changes

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Appendix 1 to Amendment A

With Replacement Paragraphs Marked-Up to Indicate Changes

Assistant Commissioner for Patents
Washington, DC 20231

COPY OF PAPERS
ORIGINALLY FILED

Sir:

Pursuant to Rule 121, the following is a copy of all of the **paragraphs amended** by the attached Amendment A, with all changes indicated by bracketing deletions and underlining additions:

[0001] A co-pending application entitled "Structures and Methods for Aligning Fibers", having application number 09/825,821, filed on 4 April 2001, is hereby incorporated herein.

[0002] This invention generally pertains to methods for adding process integration to the manufacture of fiber optic apparatuses implemented with side-polished fiber optics. This invention also pertains to integrated apparatuses made from these methods of manufacture. Note that the word "apparatus" as used in this disclosure does not mean bare, un-altered, fiber-optic fiber, but rather one or more fiber-optic fibers with at least one of the fibers structurally altered from its original, generally circular or elliptical, cross-sectional shape (e.g. by side-polishing) and/or made to interact optically with another fiber over a finite length of fiber.

[0003] There is no prior art method or apparatus published, or on the market, for fully utilizing the advantages of integrated processes with silicon to manufacture side-polished fiber optic apparatuses and systems, other than the photomasking of multiple features such as grooves, or the deposition of coatings. What is known in the prior art deals with individually placing fibers in grooves, one-at-a-time. Once placed they may all be polished in one step. This prior art is limited to the manufacture of side-polished fibers to implement two-port photonic functions. This known art is taught in the U.S. patents [2]5,781,675 "Method for preparing fiber-optic polarizer" and [1]5,809,188 "Tunable optical filter or reflector", both by Tseng.

In those patents, Tseng teaches the use of a set of parallel and variable-depth V-g etched in a common silicon crystal substrate to simultaneously achieve both a) prec control of remaining side-wall thickness left on each fiber held within each of the V-g b) arcuate paths for the fibers which enable the side-polished regions to be of a controll length, and c) simultaneous deposition of one or more films on the set of side-polished regions. Not taught in the above patents are multi-function apparatuses or methods for manufacturing multiple apparatuses on a common fiber without fuse splicing or physical connectors. Also not disclosed are a) methods or apparatuses for fabricating multiple units simultaneously, other than the substrates themselves or 2-port polarizers or filters; b) methods or apparatuses wherein some multiples of individual apparatuses are formed with at least one fiber in common; or c) any methods or apparatuses for fiber-to-fiber alignment when coupling side-polished areas to one another between fibers in respectively different substrates.

[0042] The last portion of the process is depicted by FIG. 2I. FIG. 2I shows the substrates 31 and 58 parted, leaving a freestanding, bonded 4-port coupler 59. What is not shown is that prior to parting the two substrates 31 and 58, the replacement bonding material holding the end portions of the fibers 42 and 54 into place in their respective substrates 31 and 58 is first loosened by a solvent or by heating. As a freestanding 4-port coupler 59, its two fibers 42 and 54 are now affixed together but free of the substrates 31 and 58. Note that the substrates 31 and 58 may now be reused to make yet another such apparatus. This potential reuse of the silicon substrates can significantly lower the cost of producing 4-port couplers. This separation of a fiber optic apparatus from a substrate also removes thermal expansion mismatch issues as mentioned in the above referenced US patent 4,475,790 by Little, titled "Fiber optic coupler".

Appendix 2 to Amendment A

With Replacement Claims Marked-Up to Indicate Changes

Assistant Commissioner for Patents
Washington, DC 20231

Sir:

Pursuant to Rule 121, the following is a copy of all of the **claims amended** by the attached Amendment A, with all changes indicated by bracketing deletions and underlining additions:

1. **(amended)** A multiple fiber optic apparatus comprising:

a) a crystal substrate having a first surface;

b) a first array of grooves etched into said first surface;

c) a [second]first array of side-polished optical fibers held within said first array of grooves,

wherein said first array of side-polished optical fibers held within the [common]substrate form a mechanically integrated set of fiber optic apparatuses[which may be of different types].

2. **(amended)** The multiple fiber optic apparatus of claim 1, wherein at least two of said side-polished optical fibers are[actually] continuous parts of a single fiber looped around to pass through at least two of the grooves in said first array of grooves.

7. **(amended)** An integrated multiple fiber optic apparatus comprising:

(a) at least two substrates, wherein each said substrate has a first surface with a first array of grooves suitable for holding an array of side-polished fiber optics; and

(b) at least one array of side-polished fiber optics having side-polished areas sandwiched within and between said grooves of two said substrates;

wherein said first surfaces of said two substrates are positioned substantially plane-parallel and facing one another, and

wherein the two arrays of grooves are aligned substantially opposite to one another.

8. **(amended)** The integrated multiple fiber optic apparatus of claim 7, wherein at least one of said side-polished [fiber-optics is]areas participates in forming a 4-port apparatus.

10. **(amended)** A multiple fiber optic apparatus comprising:

(a) at least a first fiber;

(b) at least two [or more]side-polished areas spaced a distance apart lengthwise along said first fiber;

(c) at least two [or more]substrate portions[, with one] each associated with[each said]a respective one of said two side-polished areas;

wherein there are no splices or connectors [used]within said first fiber along said distance[first fiber between at least two of said substrate portions associated with said side-polished areas].

11. **(amended)** The multiple fiber optic apparatus of claim 10 further including a substrate strip having a first side opposite a second side, wherein said two[or more] substrate portions are common to said substrate strip, and wherein each of said substrate portions includes a respective portion of groove used to hold the fiber.

12. **(amended)** The multiple fiber optic apparatus of claim 11, wherein said [first fiber forms at least one loop between two of said substrate portions]substrate portions on said substrate strip are located at one of the group including on the same side and on opposite sides.

14. **(amended)** The multiple fiber optic apparatus of claim 13[forming], wherein said 4-port apparatus is an optical add-drop multiplexer.

15. **(amended)** A multiple fiber optic apparatus comprising:

(a) multiple substrate strips, wherein at least two contain multiple grooves; and

(b) multiple side-polished fiber optic apparatuses of which at least two are each sandwiched between a pair[s] of said substrate strips and each held within a pair of the grooves;

wherein [the substrate strips are stacked into a compact array;]at least some of said multiple side-polished fiber optic apparatuses, with their sandwiching pair of substrate strips, are able to be stacked to form a multidimensional array of fiber optic apparatuses. [whereby a two-dimensional array of fiber optic apparatuses is achieved.]

16. **(amended)** A freestanding, 2-port, side-polished, fiber optic apparatus comprising a fiber having a side-polished area, wherein said side-polished area spans a lengthwise segment of the fiber whereover said fiber is supported only by the rest of the fiber.

18. **(amended)** A freestanding, 4-port, side-polished, fiber optic apparatus comprising:

(a) [two]a first fiber[s each] having a first side-polished area spanning a first length-segment of said first fiber;

(b) a second fiber having a second side-polished area spanning a second length-segment of said second fiber;

(c) a bonded interface between said first and second side-polished areas, wherein said interface spans a lengthwise segment of the fibers;

wherein the fibers are supported by a substrate only outside said lengthwise segment.

19. **(amended)** The freestanding, 4-port, side-polished, fiber optic apparatus of claim 18 further including one or more thin films in said bonded interface between said side[ ]-polished areas.